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February 2, 1973

TYPE I PROGRESS REPORT, No. 3 for the period ending January 31, 1972.

Title of the Investigation with ERTS-A Proposal Number:
Investigation of Application of ERTS-A Data to Integrated State Planning in Maryland
MMC 261

GSFC ID: ST 352

A. OBJECTIVE

The objective of this project is to evaluate the utility of satellite and aircraft remotely sensed data in integrated state planning. To achieve this objective, remotely sensed data are being evaluated for their applicability to land use inventory, land capability evaluation and land use suitability in the State of Maryland. Remotely sensed data are being integrated with other data to consider it's applicability in the framework of state planning methods.

B. SUMMARY OF WORK PERFORMED

I. A number of major steps have been taken to move forward in the efficient completion of this investigation. The following tasks have been addressed during this reporting period; task completion or progress will be noted.

TASK DESCRIPTION	PERFORMANCE
(A) 1970 LAND USE INVENTORY	
1. Identify Sub-Areas Within Maryland	Completed. The 23 counties and Baltimore City is organized by seven administrative planning regions. The Land Use Inventory for the Eastern 6 regions have been prepared by U.S. Geological Survey-Geography Applications Program as part of their efforts in the CARETS program. EarthSat has inventoried and mapped Land Use in the Western Maryland regions, and delivered this product to DSP.

2. Adopt Land Use Inventory Scheme - Completed. Land Use classification scheme adopted for the Maryland Land Use Inventory was developed by the USGS, as reported in GSC #671, "A Land Use Classification Scheme for Use in Remote Sensor Data" by Anderson, Hardy, and Roach, 1972.

3. Guidelines for Aerial Photo Interpretation - A discussion paper prepared by USGS-GAP (CARETS Project) adequately documents the interpretation procedures and techniques used for mapping land use in Maryland. These techniques and procedures were used by EarthSat in Western Maryland with only minor modifications. Therefore, DSP and EarthSat have mutually agreed not to duplicate this effort.

4. Classification of State Land Use - Completed. Western Maryland region has been classified as to land use categories as mentioned in Progress Report No.3; also EarthSat received the USGS-GAP Land Use maps on January 16, 1973 to complete the statewide inventory.

5. Refine Existing Inventory - Discussions with DSP have resulted in an in-depth examination of the high altitude U-2 imagery for finer category discrimination in urban and suburban areas. This examination is still in progress. See B.3.

6. Ground Truth Where Necessary - As reported in Progress Report No. 3; field work was conducted in the three counties of Western Maryland region to check and resolve land use interpretation ambiguities.

7. Land Use Map Product - Substantially completed. Western Maryland region Land Use map has been completed by EarthSat at a scale of 1:126,720 and delivered to DSP. USGS-GAP land inventory maps have been received by EarthSat. These 16 separate sheets which complete the total state coverage at a scale of 1:100,000 have been mosaicked and subsequently divided into 6 planning regions. These regional maps will then be photographically reduced to a scale of 1:126,720 for further analysis.

8. Quantification by Class in Appropriate Format - Partially completed. Quantification of the 1972 General Land Use Map of Western Maryland was completed using a Martin-Kuykendall area calculator. The results, collected for 16 land use classes and accumulated at the electoral district level, have been sent to DSP.

The time required for the land use quantification of the balance of the State using this same method has been estimated by EarthSat. Tabulated results in an appropriate format for the Western Maryland inventory have been delivered to DSP.

(B) CAPABILITY AND SUITABILITY ANALYSIS

1. Identify Capability Classes with DSP - Substantially completed. Continuing exchanges and discussions with DSP have resulted in a substantial agreement as to the identification of an operationally defined set of capability analysis parameters. These will be fully reported on in the next reporting period.

2. Identify Suitability Classes with DSP - Substantially completed. Continuing exchanges and discussions with DSP have resulted in a substantial agreement as to the identification of an operationally defined set of suitability analysis elements. These will be fully reported on in the next reporting period.

   Data sources to fulfill the information requirements for capability and suitability classes were identified. Two alternative approaches for collecting, assembling, and representing the information were thoroughly investigated by EarthSat - a direct map overlay (analog system) and a geo-base computer system (digital). Each alternative has been detailed, itemized, and costed by EarthSat and presented to DSP for their preference. After careful deliberation, a clear decision was made by DSP to carry out the capability and suitability analysis through digital techniques.

3. Critical Areas as Defined by State - Partially completed. DSP had defined four critical areas which are to be subjected to a more detailed examination: 1) the Worcester County Northern Shoreline; 2) Deep Creek Lake area in Garrett County; 3) the location of all marinas along the Chesapeake Bay shores, and 4) the Laurel, Bowie, and Columbia areas in the Washington, D. C. - Baltimore corridor area. Updating and refining the land use inventory has begun in Worcester County, and the coastal marinas are being delineated on the appropriate maps. (See D.1.)

4. Define Guidelines for Capability - Partially completed.

5. Define Guidelines for Suitability - Partially completed. A series of discussions and memoranda have generated detailed guidelines for capability and suitability analyses. EarthSat has itemized the data input variables for capability studies and determined the digital encoding cost for three different levels of effort and accuracy, which follow:

   a) Encoding only the predominant items per data cell
   b) Encoding of predominant and secondary items for natural soil groups, land use, and engineering geology, as well as predominant items for all other capability parameters
   c) Encoding of predominant, secondary, and tertiary items for the natural soil groups, predominant and secondary items for land use and engineering geology, and predominant items for all remaining parameters.

   Algorithms and decision rules will have to be developed to guide output models for capability and suitability characteristics.

6. Determine Capability from Images/Supplementary Data - In progress.

7. Determine Suitability from Images/Supplementary Data - In progress. Existing information bases relating to capability and suitability data requirements have been noted, and recommendations by EarthSat have been proposed to DSP for preparing the additional information bases necessary to provide a complete statewide base. All of the imagery received by EarthSat has been catalogued, and evaluated for its potential contribution for analysis, and is being readied for digital encoding.

8. Ground Truth Capability Where Necessary - Not relevant at this time.

9. Ground Truth Suitability Where Necessary - Not relevant at this time.

10. Capability Map Products by Planning Regions - Not yet begun.

11. Suitability Map Products by Planning Regions - Not yet begun. Will be carried out digitally in due course.

12. Quantify Capability Map by Class/Tabular Form. Quantification of all input and output maps will be obtained in the digital process, broken down by electoral district and aggregated by county and state planning regions.

13. Quantify Suitability Map by Class/Tabular Form. Quantification for all input and output maps will be obtained in the digital process, broken down by electoral district and aggregated by county and state planning regions.

(C) TECHNIQUES FOR UPDATING LAND INFORMATION

1. Land Use Inventory - Nothing at this time.

2. Capability Classes - Nothing at this time.

3. Suitability Classes, Through Use of Remote Sensing/Including Satellite ERTS Data - Nothing at this time.

4. Determine Short Range Data Storage Display for Images and Interpretation - Completed. For ease and accuracy in determining aerial and space image coverage for the State, all of the imagery received by EarthSat has been catalogued and documented by location, cloud cover, type of film, scale of imagery, and date of coverage. In addition, transparent overlays have been prepared showing flight line coverage and the location of individual phtographic frames for each set of imagery received of Maryland.

5. Implement Item 4 (Above) - Substantially completed in the sense of being up-to-date. The location off all the imagery of Maryland received by EarthSat has been plotted on transparent overlays for each imagery set; flight lines and frame locations have been delineated. A continual update of ERTS imagery and supportive U-2 data is planned.

6. Advise Agency in Definition of Long Range Information System Requirements - Nothing at this time.

(D) TEMPORAL LAND USE ANALYSIS AND 1972 UPDATE

1. Temporal Analyses of Land Use in Selected Areas - In progress. 1972 imagery of Worcester County is being studied to delineate recent changes in land usage, and to document refinements in land use breakdown. RC-10 CIR imagery obtained on August 22, 1972, provides the current 1972 information base. Coastal housing developments reflect most of the changes. Breakdown of

each second digit in the USGS-GAP classification will be attempted with the RC-10 images.

2. Land Use Inventory Update to 1972 - No report.

3. Temporal Analyses Map Products - No report.

4. Land Use Update (1972) Map Products - No report.

5. Quantification by Class for Land Use (Temporal) - No report.

6. Quantification by Class for Land Use (Update) - No report.

(E) FORMULATION OF LAND RELATED GOALS AND POLICES

1. Assist DSP in Formulating Land Related Goals Using Material Generated Under This Contract - No report.

(F) REVIEW OF PRELIMINARY, ALTERNATIVE LAND USE PLANS

1. Review DSP Preliminary Alternative Land Use Plans With Respect to Integrity to Materials Developed Under This Contract - No report.

(G) EVALUATE REMOTE SENSING INFORMATION

1. Land Use Inventory - In progress. All ERTS-1 imagery received is being scanned and evaluated as to the degree which certain land use characteristics are depicted and emphasized. The four different MSS bands are compared as to which best reveals a characteristic, and the rating is recorded. It is anticipated that seasonal variations and their subsequent effects on the environment will be reflected in the tabulated results of this evaluation.

2. Capability Information - No report.

3. Suitability Information - No report.

4. Compare Usefulness of Satellite to Other Imagery - In progress. Selected portions of ERTS-1 imagery of Maryland are being photographically enlarged to yield a scale congruent with the prepared land use maps. A direct comparison will then be made as to the contribution black and white satellite imagery processed by the common NASA procedures can be expected to make for State planning. Other tests are planned.

5. Determine Level of Utility of Satellites for Significant Contributions. - No report.

6. Compare Incremental Costs/Savings vs. Common Data Sources - No report.

(H) FUTURE SATELLITE/AIRCRAFT COVERAGE AND REQUIREMENTS

1. Define (with DSP) Future State Activities Using Satellite and/or Aircraft Imagery - No report.

2. Define Sensors, Frequencies (time) etc. - No report.

3. Recommend Procedures for ERTS-B and Operational Satellites Underway. EarthSat has advised DSP and collaborated with DSP in determining the operational requirements necessary for the direct application of ERTS-B data for State planning decision making.

(I) COORDINATION

1. With DSP Approval Coordinate With Other P.I.'s in Maryland or Nationally on Studies Relevant to DSP Activities - No report at this time.

II. DSP has initiated a project with the Maryland Soil Conservation Service, at the recommendation of EarthSat, to prepare a statewide Natural Soil Group Map. This project, funded independent of NASA support monies, will greatly aid in the capability analysis of Maryland.

III. Also independent of NASA support funds, EarthSat and Maryland DSP collaborated on the preparation and submission of an ERTS-B proposal titled, "Application of ERTS-B Data to Comprehensive State Planning in Maryland".

C. WORK SCHEDULE

To date, work progress has been completed in accordance with scheduled project tasks.

D. PROGRESS ANALYSIS

The major decision by DSP to proceed with capability and suitability studies via digital analysis represents substantial progress. Efforts now may be directed towards assembling and preparing the necessary inputs for digital analysis.

USGS-GAP land use delineations of Eastern Maryland were received by EarthSat on January 16, 1973. Comparative analysis may now proceed using these maps as a base; land use class refinements, updates and change analyses may be initiated.

E. PROJECT RELIABILITY

The high quality of the supporting data on capability and suitability now being readied for encoding will ensure that a high quality consistent evaluation base for comparison with ERTS data will be available in Maryland.

F. ADEQUACY OF FUNDS

It has become quite evident that the allotted funds are not adequate to cover the various issues in this contract. Additional funding would substantially increase the general operations applicability of the planning

program within the Maryland planning context. It would also significantly increase the applicability of the project results to other states. Additional funding will be sought within days of this report being submitted.

G. PERSONNEL CHANGES

Because of a shift in project emphasis resulting in a sharper focus on on physical determinations of capability and suitability parameters, EarthSat has internally changed its project director for this contract. Dr. David S. Simonett now manages EarthSat's responsibilities for this investigation. This change has received the approval of the Maryland Department of State Planning.

H. SUMMARY OF WORK PLANNED

1. The USGS-GAP land use maps aggregated by state planning region will be photographically reduced to an approximate scale of 1:126,720 for further analysis.

2. Continued investigation of the critical areas as established by DSP will result in more detailed analysis of these areas. The Bowie, Laurel and Columbia areas of the Baltimore-Washington axis will be examined in detail; the locations of all coastal marinas will be completed and represented by a suitable format; Deep Creek Lake area will be studied to show the effects of residential encroachment, Worcester County shoreline will receive a more precise evaluation of land uses; breakdown below the second digit level in the USGS-GAP land use classification will be attempted in all areas.

3. Digital encoding procedures will be selected, and algorithms and decision rules for directing the computer models will be addressed by DSP and EarthSat.

4. In addition, the manual film storage retreival system developed for a short range data storage display will be completed and presented to DSP with instruction for use and organization.

5. Temporal land use analyses will be initiated in selected areas within Maryland.

6. Specific areas within ERTS imagery will be photographically enlarged to a scale congruent with the existing land use maps. A careful examination of the satellite delineations will serve as the basis for evaluating the contribution of ERTS imagery to land use planning.

7. ERTS-1 data will be analyzed as received and the application of these data to the planning and contract objectives will be further evaluated.